

JPRS 78876

1 September 1981

West Europe Report

SCIENCE AND TECHNOLOGY

No. 72

FBIS

FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available from Bell & Howell, Old Mansfield Road, Wooster, Ohio 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

1 September 1981

WEST EUROPE REPORT SCIENCE AND TECHNOLOGY

No. 72

CONTENTS

CHEMICALS

- Glass-Mat-Reinforced Thermoplastic: Strong, Easy To Work
(Martin Welz, et al.; TECHNISCHE RUNDSCHAU, 2 Jun 81) 1

ENERGY

- Solar Project at Almeria Nears Completion
(Hans Pricker; CHEMISCHE RUNDSCHAU, 25 May 81) 15
- German-Argentine Experiment: Vertical-Rotor Wind Engine
(Peter Raabe; DER TAGESSPIEGEL, 4 Jul 81) 18
- Briefs
Tracking Solar Generator 20

INDUSTRIAL TECHNOLOGY

- Definition Phase Complete for Citroen's Flexible Workshop
(Alain Perez; INDUSTRIES & TECHNIQUES, 10 Jun 81) 21
- Latest Technologies Applied at Charleville Foundry
(Jean Deflacieliere; INDUSTRIES & TECHNIQUES, 10 Jun 81) ... 25
- Company Will Market Small, Modular Flexible Workshop
(Daniel Coue; L'USINE NOUVELLE, 30 Jul 81) 30
- Automated Production of Nuclear-Related Catalytic Elements
(Jacques Antoine; L'USINE NOUVELLE, 30 Jul 81) 33

SCIENCE POLICY

- FRG's Position in World R&D Community Assessed
(Werner Gries; FRANKFURTER ZEITUNG/BLICK DURCH
DIE WIRTSCHAFT, 17 Jul 81) 40

TRANSPORTATION

Citroen Visa II New Technology Motor (L'ARGUS DE L'AUTOMOBILE, 2 Apr 81)	43
---	----

CHEMICALS

GLASS-MAT-REINFORCED THERMOPLASTIC: STRONG, EASY TO WORK

Bern TECHNISCHE RUNDSCHAU in German 2 Jun 81 pp 33, 35

[Article by Engineer Martin Welz, Dr Erhard Siler, BASF [Baden Aniline and Soda Factory] Engineer Hartmut Schriever, Elastogran Lemfoerde: "Glass-Mat-Reinforced Thermoplastics (GMT)--Possibilities with a New Raw Material"; from the plastics laboratory of BASF, D-Ludwigshafen/BASF, Switzerland, AG [Incorporated], CH-8820 Waedenswil]

[Text] A synthetic sheet metal which, on the one hand, is as strong and rigid as steel and which can be processed as rapidly as sheet metal itself but which is also corrosion-proof, which is easily shapable and which is as light as synthetic material has always been a dream of processors and users. We believe that we have come closer to that goal in the form of GMT [glass-mat-reinforced thermoplastics].

Semifinished Product Manufacture

Glass-mat-reinforced thermoplastics are plate-like semifinished products made of thermoplastics with long glass fibers as reinforcement. One can use all easily-flowing thermoplastics as matrix material, such as PE, PP, PS, PA, PVC (Figure 1). Polypropylene is preferred here. In case of higher requirements in terms of heat-shaping resistance ($>130^{\circ}\text{C}$), polyamide is used as polymer matrix.

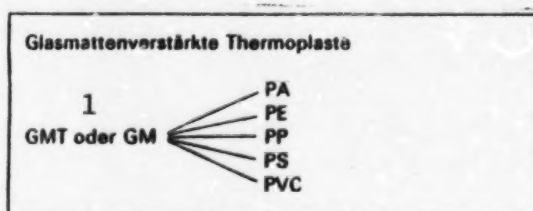


Figure 1. Glass-Fiber-Reinforced Thermoplastics. Key: 1--Or.

The long glass fibers used as reinforcement are present in the form of irregularly placed endless strands and, by virtue of their statistical, unoriented position, create a manifestation which is equal on all sides in the plane and adequate mobility during the shaping of the semifinished product. Endless glass fiber mats,

such as they are offered for the reinforcement of UP resins in manual laminating Prepreg methods, are of only limited use in thermoplastics reinforcement because of the fact that their bonding agents and their facings which are coordinated for UP resins. By means of specifically oriented optimization of glass mats and matrix materials, it is possible to make semifinished products with adjusted shaping and flow performance.

Semifinished product manufacturing is accomplished continually through the broad-slit extrusion of the thermoplastic material. The soaking of glass fibers with the polymer melt is so performed by means of special process engineering measures that a uniform distribution of the glass fibers is achieved in the plate along with intensive cross-linking with the polymers, without any noteworthy air inclusions [trapped air].

The production facility at the BASF affiliate Elastogran will soon turn out GMT semifinished products with a width of up to 1.4 m and thicknesses of about 1-6 mm. Normally, right-angle patterns are delivered but in thicknesses up to a maximum of 3 mm, GMT can also be wound up into coils and thus can be processed in a manner similar to sheet metal.

Various coatings can be applied during semifinished product manufacture, such as, for example, metal foils, synthetic leather, or also thermoplastic foil paper or decorator materials so that any additional lamination expenditure can be eliminated.

In contrast to hardenable semifinished products, such as SMC, GMT can also be stored in an unlimited manner as semifinished material.

Properties

The properties of GMT are determined by matrix material, glass fiber content and type, filler materials, and to a minor extent also by the processing conditions. The effect of the processing conditions on the finished part properties on the other hand is much greater and less well controllable in the case of systems which are cross-linked only during the shaping process. In the case of GMT, the semifinished product properties extensively correspond to those in the finished parts. This makes the design and layout of practice parts easier, starting with the measured property characteristics of the compound raw material.

In Figures 2 and 3 we compare our own standard products, a polypropylene, containing about 30 percent glass fibers, with steel plates and SMC (30 percent glass fibers).

Figure 2 represents the first column, the E-module. Steel plate is superior both to SMC and GMT regarding the pure material properties. But if we make parts of identical bending resistance from these three materials, then the GMT or SMC parts are only half as heavy as the parts made of steel (third column). The middle column tells us by how much thicker a GMT (3.7 x) or a SMC part (2.6 x) has to be than a corresponding steel part in order to attain the same rigidity.

In Figure 3, we have a comparison of the corresponding materials regarding strength. The first column represents the strength in N/mm^2 ; here, steel plate reveals between three and five times the value as compared to SMC and GMT. However,

related to the specific weight, the strength figures (tear distances) of GMT and steel plate are comparable and in the case of SMC they are even better.

Other important properties are illustrated in Table 1 as a function of the matrix material and in comparison to injection-molded trial bodies made of short-glass-fiber-reinforced thermoplastics.

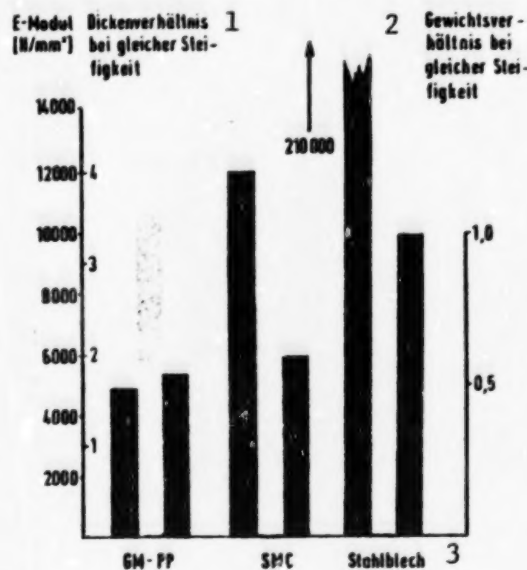


Figure 2. E-Module, Thickness and Weight Comparison of GM-PP With Respect to SMC and Steel Plate. Key: 1--Thickness ratio with same strength; 2--Weight ratio with same strength; 3--Steel plate.

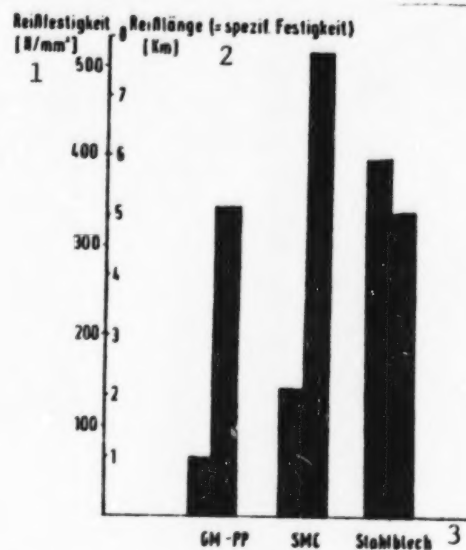


Figure 3. Tear Strength and Tear Distance GM-PP Compared to SMC and Steel Plate. Key: 1--Tear strength; 2--Tear distance (= specific strength); 3--Steel plate.

Table 1. Properties of GMT, Compared to Other Reinforced Synthetic Materials

Eigenschaft 1		2 Glasmatteverstärkte Thermoplaste (GMT)			SMC	3 GF-PA 6 Luftschicht (Ultramid B3WG7)	
		PP (*Novolen)	SAN (*Luran)	PA 6 (*Ultramid)		in Spritz- richtung 4	senkrecht zur Spritz- richtung 5
Glasgehalt 6	15 (Gew.-%)	25-35	25-35	30	30	35	
	(Vol.-%)	11-17	12-19	16	15	19	
spezifisches Gewicht 7	(g/cm ³)	1,08-1,17	1,26-1,35	1,35	1,65	1,39	
Reißfestigkeit 8	(N/mm ²)	50-70	60-80	70-98	85	96	52
Biegefestigkeit 9	(N/mm ²)	60-100	105-125	70-160	160	150	-
Zug-E-Modul 10	(N/mm ²)	3900-5500	6800-8400	3800-6300	7100	7300	2760
Arbeitsaufnahme (Fläche 11 unter dem σ - ϵ -Diagramm)	(N/mm ²)	1,5	1,1	1,5-1,2	~1,2	5,4	-
therm. Längenausdeh- 12 nungskoeffizient α	(K ⁻¹)	45-25 · 10 ⁻⁶	30-20 · 10 ⁻⁶	-	20 · 10 ⁻⁶	20 · 10 ⁻⁶	-
dielektr. Verlustfaktor 13 $\tan \delta$ bei 10 ⁶ Hz		0,002	0,014	0,065	0,05		0,19
max. Temperatur (kurzzeitig) 14	(°C)	130	95	150	180	180	

Key: 1--Property; 2--Glass-mat-reinforced thermoplastic; 3--Air-humid; 4--In injection device; 5--Perpendicularly to the direction of injection; 6--Glass content; 7--Specific weight; 8--Tear strength; 9--Bending strength; 10--Traction E-module; 11--Energy absorption (surface below σ - ϵ diagram); 12--Thermal longitudinal stretch coefficient α ; 13--Dielectric loss factor $\tan \delta$ at 10⁶ Hz; 14--Maximum temperature (short-term); 15--Percent by weight.

As semifinished material, GMT is quasiisotropic in terms of the surface, that is to say, the properties are independent of the direction in terms of the plane. Due to the flow action during the further processing of the semifinished material, the glass fibers can be lined up as a function of the shape outline and the flow path and as a result of that we can get somewhat differing properties as compared to the semifinished material. If the material and the pattern are skillfully selected, this peculiarity can even be utilized in order more effectively to strengthen an unsymmetrically stressed shaped part in the main direction of stress.

The anisotropy of injected, short-fiber-reinforced thermoplastics is much more pronounced, as we can see in the last two columns in Table 1. The E-module and the strength here can be greater in the direction of injection, up to a factor of 3, than in a direction perpendicular thereto. This anisotropy which in most cases is undesirable (especially when we deal with large-surface injection-molded parts) is very difficult to influence for example through the selection of a different jet system. The measurements values on injection-molded samples, used below for comparison purposes, were always taken in the direction of injection and therefore give us excessively high measurement values in comparison to the quasiisotropic GMT.

Synthetic materials alter their properties under the influence of stress, temperature, time, and environmental media more than this is the case for example with steel plate.

Figure 4 shows the time creep strength of GMT as a function of the matrix material at various temperatures up to a stress time of 10,000 hours. It is interesting here to note the uniform level at high temperatures. The creep tendency of thermoplastics is thus heavily reduced by means of long-glass-fiber reinforcement.

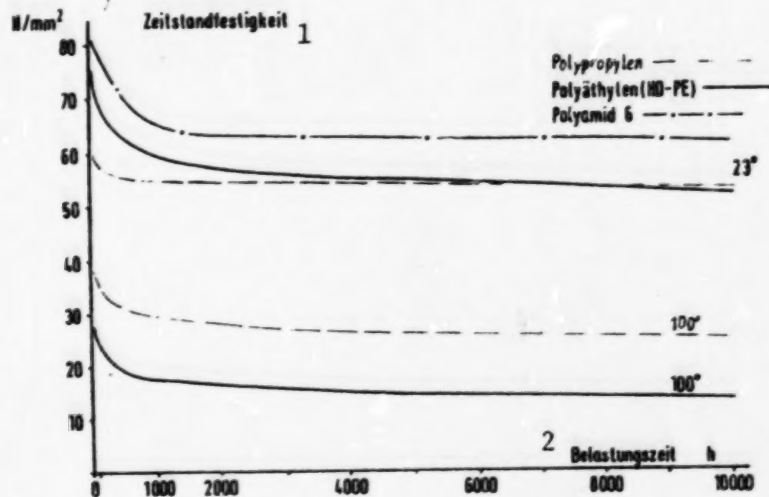


Figure 4. Time Creep Strength of Glass-Mat-Reinforced Thermoplastics. Key: 1--Time creep strength; 2--Stress time.

The dynamic properties of mat-reinforced thermoplastics are also very good. The samples are stressed in the alternating bending experiments with about 35 percent of the short-time creep strength at a frequency of 15 Hz more than 20 million times without any rupture (Figure 5). During this dynamic test, no serious temperature rise was observed, such as it otherwise leads to premature failure in the case of unreinforced or short-glass-fiber-reinforced samples.

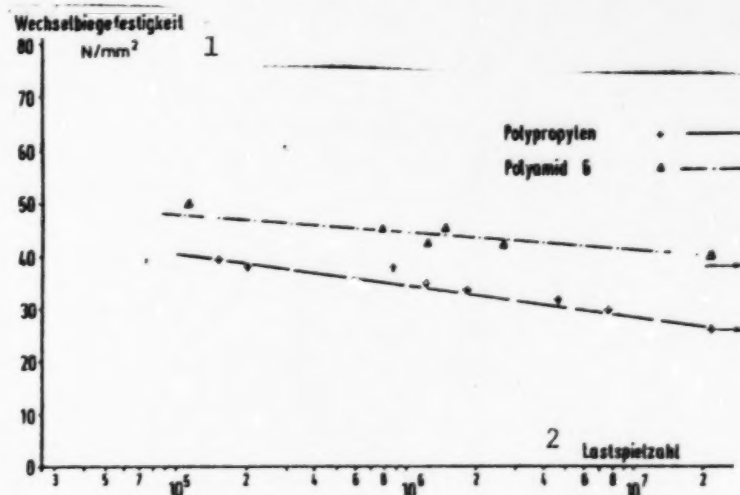


Figure 5. Alternating Bending Strength of GMT. Key: 1--Alternating bending strength; 2--Stress cycle criterion.

GMT on a base of tough thermoplastics, such as, for example, polyolefins or polyurethane, have a definitely benign rupture behavior because excessive local stress does not lead to catastrophic failure (separation fracture).

One of the serious disadvantages of synthetics is the temperature dependence of the properties. For example, the shock resistance of thermoplastics decreases as the temperature goes down. By means of reinforcement with long-fiber glass mats we can achieve extensive independence of the temperature (as we can see in Figure 6) along with a level which is increased five times compared to the short-glass-fiber reinforcements.

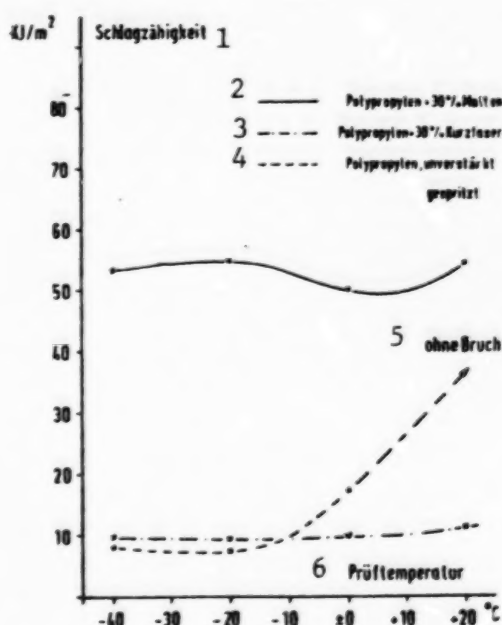


Figure 6. Shock Resistance as a Function of Testing Temperature. Key: 1--Shock resistance; 2--Polypropylene + 30% mats; 3--Polypropylene + 30% short fiber; 4--Polypropylene, unreinforced, injected; 5--No rupture; 6--Testing temperature.

The dependence of the E-module of various glass-mat-reinforced thermoplastics was measured in the bending-oscillation test and is illustrated in Figure 7. In designing load-bearing GMT parts, one must consider the drop of the E-module in the utility temperature range. Resistance to environmental media is important also to the lifetime and usefulness of mat-reinforced thermoplastics. During weathering in the Xeno test instrument, the E-module remains approximately constant while the tear strength, as shown in Figure 8, above all during the first 1,000 hours of weathering drops by as much as 40 percent; 1,000 hours in the Xeno test instrument corresponds to about 7,000 hours of summertime weathering.

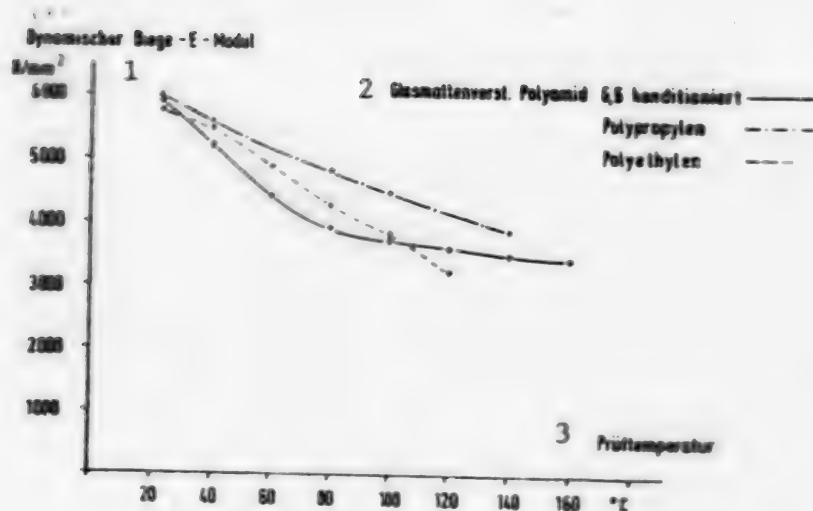


Figure 7. Dynamic E-Module as a Function of the Temperature. Key: 1--Dynamic bending E-module; 2--Glass-mat-reinforced polyamide, 6.6 conditioned; 3--Testing temperature.

Because GMT on a polyamide base is also supposed to be used in the combustion engine sector, we tested the resistance in oil at 120°C, in a water and glycol mixture at 90°C and in gasoline at 50°C (Figure 9).

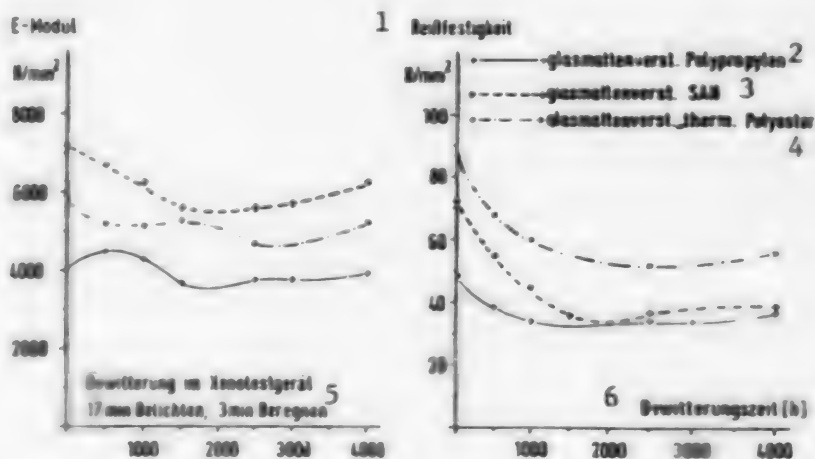


Figure 8. Properties of GMT as a Function of the Weathering Time. Key: 1--Tear strength; 2--Glass-mat-reinforced polypropylene; 3--Glass-mat-reinforced SAN; 4--Glass-mat-reinforced thermal polyester; 5--Weathering in Xeno test instrument, 17 minutes exposure, 3 minutes sprinkling; 6--Weathering time (hours).

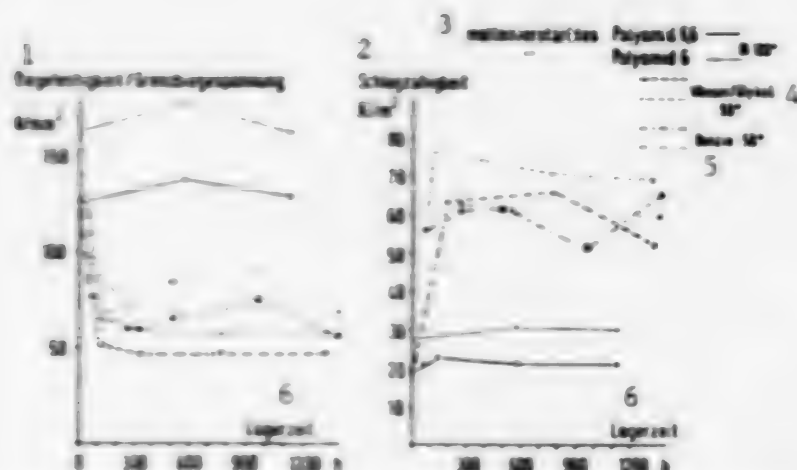


Figure 9. Properties of GM-PA in Various Media. Key: 1--Bending strength/boundary bending stress [tension]; 2--Shock resistance; 3--Mat-reinforced; 4--Water and glycol; 5--Gasoline; 6--Storage time.

Here the samples have quite different behavior. While the high bending strength and the relatively low shock strength of the dry samples remain preserved in hot oil, there is a change toward the viscous product in case of storage in glycol plus water and gasoline which is typical for polyamide also in a normal climate. The shock resistance increases almost three-fold while the bending strength or the boundary bending stress [tension] will decline to the same extent. After this adaptation to the environmental medium, which is completed in about 200 hours, the properties remain constant over a long period of time so that one can speak of a pronounced good resistance to hot oil, gasoline, and cooling water.

All glass-mat-reinforced thermoplastics--to the extent that they are not specially equipped--must be included in the category of "normally flammable" (construction material class B2 based on DIN [German Industrial Standard] 4102). By means of flame-retardant additives to the matrix material one can influence the fire or burning response to the extent that the test bodies can no longer be set afire or that the fire goes out by itself within a few seconds after ignition. Only when we use PVC as matrix material do we have a self-extinguishing piece of semi-finished material which, by means of relatively minor modifications, even reaches construction material class B1 (difficult to inflame).

Processing Technique

As in the case of steel plate, GMT, after it has been heated up externally, can be shaped in fast-flowing presses in cold tools, in the manner in which the principle is shown in Figure 10.

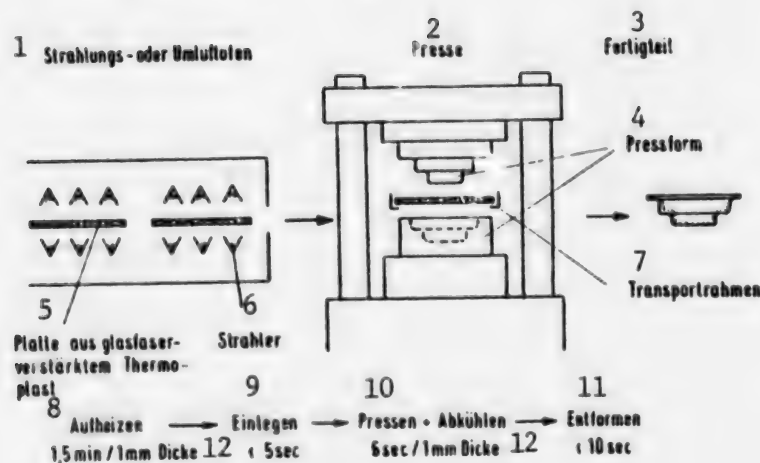


Figure 10. Principle of Deep-Drawing in Cold Molds. Key: 1--Radiation furnace or recirculated air furnace; 2--Press; 3--Finished part; 4--Pressing mold; 5--Plate made of glass-fiber-reinforced thermoplastic; 6--Heater; 7--Transport frame; 8--Heat-up; 9--Insertion; 10--Pressing plus cooling; 11--Removal from mold; 12--Thickness.

Here, in case of comparable dimensions, we can achieve shorter cycle times than during injection molding. GMT is cooled in the pressing mold only to a point below the solidification range whereas SMC gets its final character only in the (heated) mold through a cross-linking action. As a result of this, in the case of GMT, the pressing time is only 25-30 percent of the pressing time for SMC. To heat up the GMT, the furnace must be so large that the pressing time can determine the cadence, that is to say, if the heat-up time compared to the pressing time is about 10 times longer, then the furnace must be designed for ten blanks [patterns].

With the help of GMT, we can almost achieve the manufacturing times of corresponding steel plate parts. Above all it is the considerably shaped sheet metal parts which require more drawing and punching steps while only one pressing phase is necessary to make the GMT parts. Because we use GMT tools with dip edges, which do not require any subsequent cutting, it is possible to take a finished part from the mold (like sheet metal, GMT can be processed from the coil; together with the short cycle time, it is above all suitable for automatic large series production).

Medium pressed parts series however can also be made economically from GMT. Cast or milled tools made of aluminum or on a zinc base are suitable; the dip edges however should consist of steel here. Tool materials, such as hard woods and epoxyresin are suitable for prototypes and small preliminary series where optimum cycle time and mold accuracy are not important.

The heating-up can be accomplished in recycled air furnaces, in the bright or dark radiation field or between heating plates. The heating time is determined by the low heat conductivity of the synthetic materials and the limited temperature stressability particularly in case of an oxygen-containing environment. The blanks are heated up to 40-60°C above the melting range of the matrix material. Transport into the mold for example is accomplished by means of a guided frame or a wire mesh [conveyor] belt. After the deposit of the blank or blanks in the mold, the

latter must be closed very quickly--possibly within 5 seconds up to the point of pressure buildup to prevent the material from cooling off prior to the final molding.

The pressure necessary to achieve good mold filling and a neat surface depends on the speed of closing and the pressure buildup time, on the mold outline, the mold temperature, and the mold material. It is between 2 and 250 bar ($2 \cdot 10^5$ and $25 \cdot 10^6$ Pa). In case of metal mold, we must use pressures from 50 bar ($5 \cdot 10^6$ Pa) to 250 ($25 \cdot 10^6$ Pa); in case of wooden and synthetic resin molds, which do not allow the preheated blank to cool off as quickly, it suffices to have $2(2 \cdot 10^5)$ to 20 bar ($2 \cdot 10^6$ Pa).

The practical engineering properties of GMT are determined primarily by the matrix material while the processing properties (especially the flow performance) are determined by the optimum coordination between matrix material and reinforcement material. In terms of pressing technique we differentiate two processing techniques whose advantages and disadvantages are listed in Table 2, below.

Table 2.

Shaping	Flow-pressing
Insertion technique	
Mold-covering	Smaller blanks
Single-layer	Multi-layer
Advantages:	
No problems with insertion technique, easily automated	No waste
Mold parts quasiisotropic, no flow seams	Complex finished-part geometry possible
Wood or epoxyresin molds for small series	(Ribs, thickenings)
Adequate, lining possible	No dip-edge wear and tear
Disadvantages	
Dip-edge wear and tear; 5-15% waste (usable)	Exact positioning of blanks necessary, automatic insertion expensive, anisotropy due to flow orientation, weak points due to flow seams, metal molds required for necessary high pressure, lining difficult
Ribs and thickenings can be made only to a limited extent	

The impression given by Table 2 is somewhat deceptive: the advantages of shaping seem to predominate. In point of fact however flow-pressing is credited with better chances above all because the great advantage compared to sheet metal--that is to say the ability to make ribs and to make different wall thickness--can be utilized in this method.

The following two figures show experimental molded parts made of GMT: the box in Figure 11 has been shaped and its lined with a red surface foil. In Figure 12 we have a geometrically complicated molded part with various ribs, thickenings, and recesses, made according to the extrusion-pressing method.

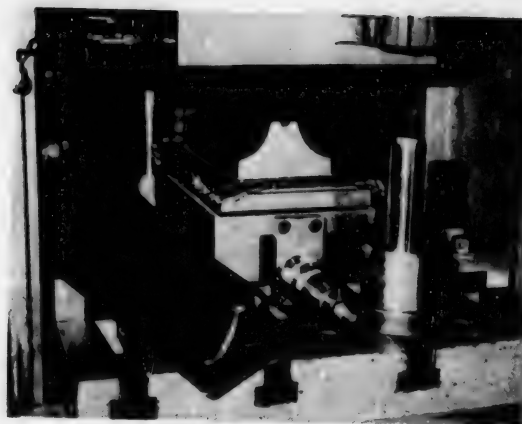


Figure 11. Experimental Molded Part.



Figure 12. Complicated Molded Part Made According to Extrusion-Press Method.

In order to keep the orientation as small as possible during extrusion pressing, it is necessary to optimize the size, number, and position of the blanks in terms of the mold. We check on the fiber position here best by means of x-ray pictures which give us clear images also in case of dyed and filled matrix materials.

Figure 13 shows such a picture of intrusion-pressed little cups of which the one on the right was pressed together from small blanks and therefore reveals strong orientations of the fibers in the areas around the edges.



Figure 13. X-Ray Image of Extrusion-Pressed Little Cups.

The processing shrinkage, which must already be taken into consideration during tool-making, depends on the glass-fiber content and the filler-material content, on the matrix type and above all on the tool temperature; it is between 0.2 and 0.5 percent.

GMT waste from semifinished product manufacturing and from cutting or waste parts can be reclaimed by means of grinding in granulate grain size and can be turned into valuable raw materials which can be reused for injection molding or extrusion.

Connecting Technique and Lining Possibilities

All connecting [bonding] techniques that can be employed with thermoplastics can be used in connection with GMT--although with one restriction: the flow of force through the long glass fibers must not be interrupted. Butt-weld seams on the other hand make no sense here; they transmit only 10-20 percent of the plate material's strength.

GMT can be bonded with itself or also with other compatible thermoplastics by means of ultrasound, hot-gas, heating-element, and friction welding. The thickness kink through the overlap (as we can see in Figure 14) can be extensively avoided under favorable conditions. The attainable quality grades for seam welding are 0.95 for ultrasound and heat-element welding; a maximum of 0.6 was achieved with ultrasound point welding.



Figure 14. Overlap Welding Without Major Thickness Kink.

Metal bushings, to be embedded in GMT, and self-cutting screws are suitable for soluble connections with ultrasound.

GMT can be coated with synthetic foil, metal foil, or textiles either during semifinished product manufacturing or during the pressing of the molded part. For metal foils and for synthetic foils not compatible with the matrix material, we need adhesion agents for adequate bonding. Such adhesion agents have been developed. They can either be applied in advance upon the foil through extrusion or solution coating or they can be applied during semifinished product manufacturing through the coextrusion of the adhesive between GMT and the foil.

By means of metal foils, we can restrict the shapability of GMT, especially by means of hard [foils], such as, for example, noble steel whereas synthetic foils and textiles can be used also in connection with heavily shaped parts (Figure 15).



Figure 15. GMT Coated With Metal Foil.

Glass-mat-reinforced thermoplastic plates are very well suited for the manufacture of sandwich plates and parts as covering layers. As core material we can use PUR hard and soft foam, polystyrene, polyethylene, and other foam, as well as wood, honeycomb cores of aluminum or paper and other light-weight construction materials.

In most material combinations, we do not need an additional adhesive between the core and the covering layers. The connection is achieved by heating up the covering layers beyond the melting temperature of the matrix materials and by pressing with the cold core material. In the case of otherwise incompatible material combinations, one can likewise achieve good adhesion through mechanical anchoring of the melt in the celled or rough core material. Adhesion-improving, low-melting intermediate layers are required in addition only rarely.

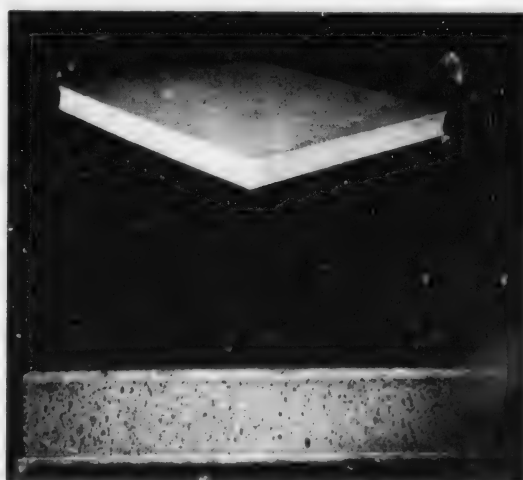


Figure 16. Sandwich Made of Glass-Mat-Reinforced Polyethylene With PUR Hard Foam.

GMT is basically lacquerable; some thermoplastics, such as, for example, the polyolefins, of course, require either a primer, on which a commercially available synthetic resin lacquer can then be applied, or a special lacquer to which adhesion-promoting additives have been added. Surface quality and in the case of lacquered

sheet metal, such as it is required for automobile outside parts, can presently be achieved in the case of GMT only through additional work processes, such as priming [with the spatula] and grinding.

Practical Uses

Glass-mat-reinforced thermoplastics are suitable for large-surface, load-bearing, or self-supporting parts. The following are currently being tested for practical engineering applications: valve lids, oil pans, carriers for bumpers and linings which are then refoamed, gear and spare-tire covers. Possible applications for example are seat shells, car-body parts in the nonvisual area, such as spoilers, engine covers, and partitions.

5058

CSO:3102/343

ENERGY

SOLAR PROJECT AT ALMERIA NEARS COMPLETION

Zurich CHEMISCHE RUNDSCHAU in German 25 May 81 pp 3, 5

[Article by Hans Fricker, head of the New Technologies department of Sulzer Brothers Inc., Winterthur: "Project 'Almeria:' Energy From the Sun"]

[Text] In the search for new sources of energy the use of solar energy is being intensely studied and promoted all over the world. In this connection the production of electricity is also of prime importance, in addition to the use of solar energy for heating homes and water.

At Almeria in southern Spain, a project simultaneously involving three experimental power plants is underway, one facility with 1,000 kW capacity built by a Spanish consortium and two with 500 kW each built by international groups within the framework of the "small solar power system" (SSPS) development of the International Energy Agency (IEA).

Sulzer participates as a major supplier to one of the facilities, in the so-called central receiver system (CRS).

CRS Facility at Almeria

The contract for the design, construction and commissioning of this facility was awarded to the firm of Interatom GmbH of Bergisch-Gladbach by the "operating agent," the German Research and Development Institute for Air and Space Travel (DFVLR), Cologne. The FRG, the United States, Spain, Italy, Belgium, Switzerland, Austria, Sweden and Greece are involved financially and through industrial deliveries in the construction of the facility, which is to begin operation in 1981.

Ninety-three mirrors (heliostats) steered by a computer reflect the sunlight at all times of the day and year into the opening of a combustion chamber (receiver) mounted on a 43 meter high tower. There, the cooling medium, liquid sodium, is heated from 270 C to 530 C, after which it flows to the hot storage tank installed on the ground. As needed, sodium can be circulated out of the tank through the steam generator into a cold storage tank and from there back to be reheated in the receiver. The steam created in the steam generator expands in a steam engine; the mechanical energy created there drives the 500 kW generator, which produces electric power.

The reasons for the choice of sodium as the cooling medium on the one hand lie in the outstanding heat transfer properties and on the other in the good storage capability. The high heat conductivity allows for the construction of relatively small equipment, whereby heat losses, in particular in the receiver, may be kept small. Simple energy storage through hot sodium is very important in particular for solar energy facilities, because the plant may be operated at peak capacity for up to 2 hours during cloudy weather, and even at night a certain amount of power production can be guaranteed. However, the sodium imposes considerable demands on the components.

Two of the most important parts of the plant are supplied by Sulzer: the receiver and the steam generator with the pressure relief system.

Receiver

Its most important technical data are:

Thermal capacity	2.7 MW
Mass flow rate	7.34 kg/s
Temperature at inlet	270 C
at outlet	530 C
Maximum thermal flux	63 W/cm ²

The core of the receiver is a pipe cluster, which consists of curved pipes with a 38 mm diameter and a 1.5 mm wall thickness, spaced 43 mm horizontally and forming a 3.6 meter high wall. These pipes are connected to each other by curved sections into six pipe coils, in which the flow is from the bottom to the top. The wall of pipes is supported by one stationary and three movable beams in such a way that the pipes at different temperatures can expand without great tension. This is an essential prerequisite for operation with rapidly changing capacity, so that when weather conditions change the isolation, for example during brief overcast periods, this can be controlled without complicated operational procedures.

Behind the wall of pipes is a wall of ceramic tiles. This wall collects the radiation which passes around the piped, about 5 percent, and also serves as a heat accumulator.

Around the wall of pipes a 6 meter high insulated box with a semicircular outline protects against excessive heat loss. Its opening of 3.4 by 3.5 meters can be tightly closed by means of two electrically operated sliding doors in order to further reduce heat losses during shady periods.

A multitude of new kinds of problems had to be resolved by means of construction, calculations and experiments. The experience gained in this way will lead to simplifications and cost reductions in future construction of similar equipment, which is of the greatest importance for the success of such solar energy facilities.

Steam Generator

Based on Sulzer's extensive experience in building high-capacity steam generators for nuclear plants, a very simple compact steam generator with a coil pipe construction was designed and built.

The data are:

Thermal capacity	2.2 MW
Sodium side:	
Mass flow rate	6.76 kg/s
Temperature at inlet	525 C
at outlet	269 C
Water/steam side:	
Mass flow rate	0.87 kg/s
Temperature at inlet	193 C
at outlet	500 C
Pressure	100 bar

The feed water which flows in from below is distributed equally to three heating surface pipes. The pipes are wound in a helical coil with a 544 mm diameter and are heated by a counter current of sodium flowing from top to bottom. The steam which is created leaves the steam generator at the top and then reaches the steam engine. A pressure relief system also guarantees the safety of the plant in the unlikely event of the bursting of a steam pipe. Just as in the receiver, the pipe mountings are constructed so that rapid changes in temperature do not lead to dangerous tensions.

Second Generation Competitive With Oil?

The experience gained in the design and construction of these components is considerable. With the operational experiences which will be gained in 1981, Sulzer will be in a position to offer even more sophisticated equipment for second-generation facilities. In so doing it will be very important, as was already mentioned, to achieve the highest efficiency with the smallest possible expenditure.

The present facilities for production of electricity through solar energy are still relatively expensive, and the power produced with it is competitive only in exceptional cases. If the predictions for the cost development of "solar power" in comparison with "oil power" are correct, solar energy could become competitive with oil in the foreseeable future. This does not, of course, hold true in comparison with large coal-fired or even nuclear facilities. However, if one takes into account that solar energy is attractive mainly to regions near the equator, where for example large nuclear plants scarcely come into question because the infrastructure is lacking, solar power plants may indeed be given a chance for success.

11949

CSO: 3102/366

ENERGY

GERMAN-ARGENTINE EXPERIMENT: VERTICAL-ROTOR WIND ENGINE

West Berlin DER TAGESSPIEGEL in German 4 Jul 81 p 12

[Article by Peter Raabe: "Wind Motor With Braking Flaps--Vertical Rotor Instead of Propeller--German-Argentine Experiment]

[Text] Wind mills and the recreated modern wind energy plants, respectively, must not necessarily be equipped with a horizontally rotating axis according to rule. Neither do they always have to feature the regular propellers. GROWIAN (being the German abbreviation for the "Large Wind Energy Plant" by Messerschmitt-Boelkow-Blohm under construction in Northern Germany) proves that a one-blade propeller will do.

A total of more than 40 wind motors designed to make power supply independent of oil are being supported by the Federal Ministry for Research and Technology. One of the most interesting projects is the wind rotor of the so-called Darrieus design which was designed by Dornier. Instead of a conventional propeller, it has a vertical rotor which makes it independent of the wind direction. In a recently commenced large-scale project in Patagonia, Argentina, investigations are under way to determine the extent of energy obtainable from the wind by means of this unusual system. German and Argentine experts have intentionally selected Comodoro Rivadavia, located 1,600 kilometers south of Buenos Aires on the Atlantic coast, as the site, because this is one of the areas on this earth with the most wind.

Famous Flettner Rotor

In former times, rotors were utilized as suppliers of energy in nautical and aeronautical engineering experiments; in either field, it was a matter of propulsion and lift energy. The Flettner rotor became particularly famous. Its inventor (Flettner) utilized the physical fact that by turning of a cylindrical roll, pressure will result on the one side, and low pressure, or suction, on the other side. These are effects which are normally caused by a ship's sail and a wing profile and thus contribute to a forward motion and generation of lift, respectively.

The wind rotor according to the Darrieus principle, however, may be compared to the Flettner rotor only with qualifications, because it features additional "wings" besides the vertical axis coupled with the power generator: a total of 3, which are arranged around the 15-m rotating axis in a crescent manner. These aluminum blades, however, are most decisive because they effect the wind motor rotation.

As Dr Joachim Dreyer, Dornier System, states, "We have given these "wings" a profile also encountered in aeroengineering, which is symmetrical and has particularly favorable aerodynamic efficiency." (As Dornier is involved in the construction of aircraft, this adaptation of aerodynamic principles is no surprise). The blades are extra-ordinarily narrow, due to the design of this wind motor as a so-called "fast runner." A wind motor with wider wings or one with a larger number of blades would turn slower and thus reduce the overall efficiency of the plant.

Movement by Means of Wind Collectors

Even starting the wind motor is comparable to starting the engines of an aircraft: the rotor does not start until it reaches a certain minimum speed. In order to reach this speed, the rotor system is sped up by means of the so-called Savonius rotors. These "wind collectors" are located at the top and bottom of the rotating axis and start with a wind velocity of four meters per second. Everything else is then done by the "wings." At approx. 80 revolutions per minute, corresponding to a wind velocity of eleven meters per second, a nominal output of 20 kW is attained.

Tested in 'Many a Storm'

The plant built for windy Patagonia had to withstand many storms as a model in the wind channel. Later, a model which was smaller compared to the now existing original was placed in the Black Forest and subsequently on an island in the sand banks of Pellworm. Here it was a matter of refining the system technically to the point that it could withstand wind velocities of up to 220 km/h. An emergency safety device is modelled after the aeroplane: Dr Dreyer states, "We installed braking flaps on the rotor blades which automatically extend by centrifugal force when the velocity becomes critical. Thus, the maximum permissible number of revolutions, 100 rev/min, will never be exceeded." If the braking flaps fail, an additional disc brake will be activated as a second braking device.

In spite of its considerable size--total height 17.5 m, 12-m diameter of the rotor system--the plant requires very little maintenance. In practice only the two rotating bearings located at the top and bottom of the axis require lubrication. The initial plan is to change the oil required for the purpose only twice a year.

Designed by aircraft designers: This wind motor built by Dornier System is independent of the direction of the wind due to its vertical rotating axis. The narrow rotor blades tested in the wind channel have optimum aerodynamic efficiency. Drum-like wind collectors at the top and bottom of the rotating axis serve as "starters." The plant incorporates simple instead of sophisticated mechanical parts, and its maintenance requirements are extremely low.

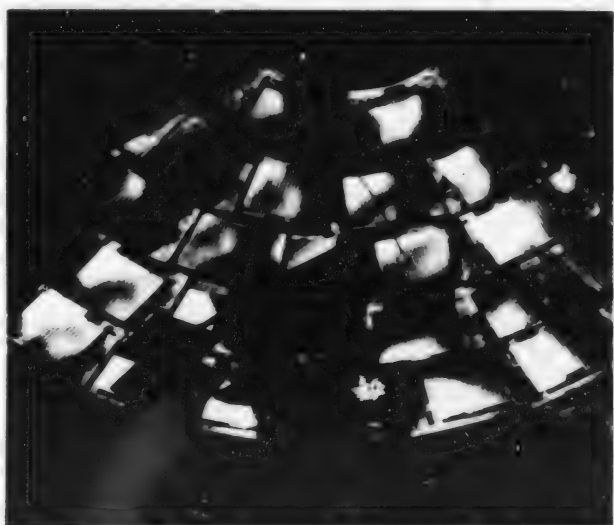
ENERGY

BRIEFS

TRACKING SOLAR GENERATOR—At the Hanover Fair, AEG-Telefunken introduced a solar generator developed in cooperation with MAN, which converts solar energy directly into electrical energy and automatically tracks the position of the sun while rotating around two axes. The 40 m² solar power station has a 1.5 kW output with full sun radiation. Due to the constant vertical impact of the sun's rays, the energy supply is 20 to 40 percent above that of a nontracking solar generator of the same size, depending on the geographical location of the site. In addition, the manufacturer has developed a procedure to reduce reflection. Each silicon cell is optically refined by means of an application by vaporization process. Our photograph shows the extraction of the cells from the vaporization carousel.

[Text] [Wuerzburg ELEKTROTECHNIK in German 11 May 81 p 5] 9544

CSO: 3102/342



INDUSTRIAL TECHNOLOGY

DEFINITION PHASE COMPLETE FOR CITROEN'S FLEXIBLE WORKSHOP

Paris INDUSTRIES & TECHNIQUES in French 10 Jun 81 pp 13-14

[Article by Alain Perez: "Flexible Shop: Citroen Raises the Curtain"]

[Text] The unit will be operational in mid-May 1983. It is a lighthouse project suited to the needs of a PMI (small and medium-sized industry) general machine shop.

The Citroen flexible workshop has now been totally defined. The final specifications were turned over to Codis on 9 June, and the only important decision still pending concerns the selection of major production equipment suppliers. The unit will also be a demonstration showcase; it is now a foregone conclusion that for equal technology, French suppliers will be the favorites in the selections that the PSA affiliate will have to make before September.

This flexible module will theoretically become operational in mid-1983 at Citroen's mechanical construction division in Meudon. The overall installation designed to machine prototype parts for the various automotive studies departments of the PSA group includes five sectors. The fabrication workshop proper, where the following will be installed: three identical five-axis palletizable machining centers, a numerical control measuring machine, an automatic robotized washing machine, and an inspection area for doubtful parts and carrier maintenance. In addition, the workshop will also include an area for palletizing and balancing of foundry castings, which is a manual station in its present configuration; a tool shop, which is itself a second flexible system designed to manage an inventory of 500-600 tools, with its own metrology and sharpening annexes; five self-propelled carriers guided with wires embedded into the floor, which perform tool transfer and transfer of rough parts, or parts in the process of being machined; and finally, a minicomputer for real-time management of all machining operations and distribution of parts and tools. The total investment amounts to 36 MF (million francs), of which one-quarter is being carried by Codis. Many suppliers are still competing at this time. For the machining centers: Grafenstaden, Forest, Cincinnati, and Kerney Trecker. On this point, the French firms will have to challenge a competition already familiarized with five-axis centers, which are made necessary by the complexity of machining operations (essentially gearbox cases and engine blocks). For the guided carriers: Saxby, Seiv, and CFC. For the cleaning machine (which will integrate a washing robot into the conventional station), the choice will be made among Mabor,

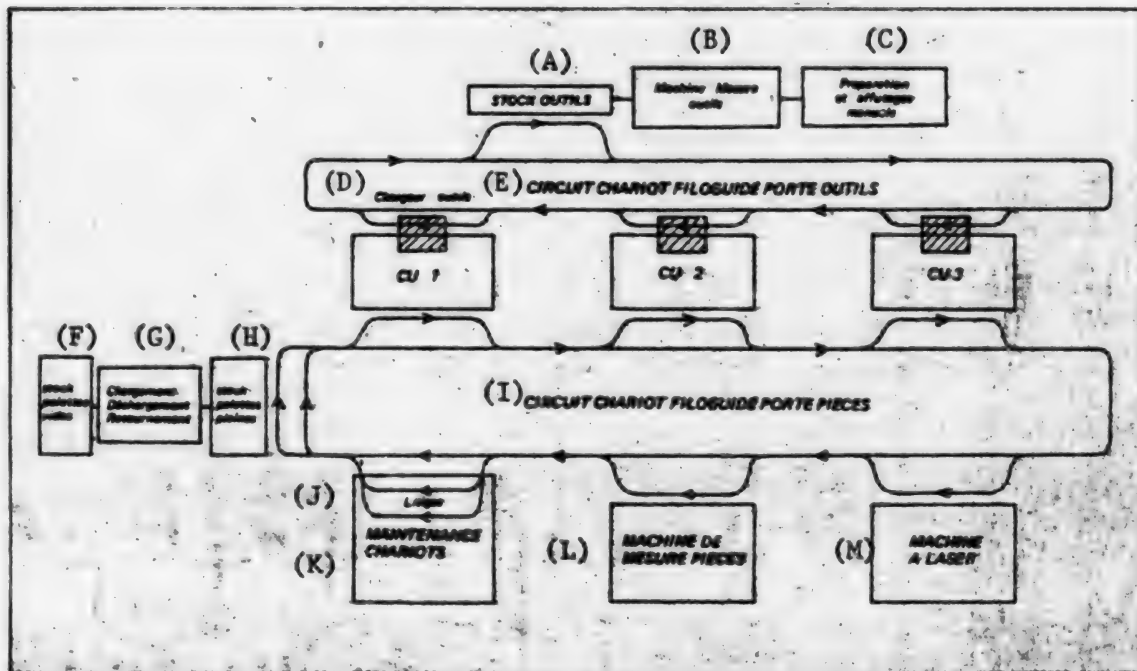


Meudon will be in charge of fabricating complex prototype parts. The goal will be to reduce fabrication delays by a factor of three.

Carrier, and Haffroy. A complete programming of the cleaning cycle is planned for this non-standard equipment, including all slant borings. The wash jet is directed by a six-axis robot, the part remaining fixed. The robot carrying the pressurized (200 bars) washing head will probably be supplied by Acma, Aoip, or Asea.

The choice is even broader for the measuring machine: Leitz, Seiv, Sagem, Zeiss, and Ferranti are still in the running. The numerical controls will be supplied by Num SA if the French manufacturer can meet the delays. As for the information tool, it will come from Sems, Cii-HB, Intertechnique, or Siemens. There are no outstanding features for this standard item, which will be the first to be ordered as of July. Language and programming will be perfected by Automatique Industrielle, which is general contractor for the project and was founded last October. Its capital is divided among PSA (40 percent), the Societe Generale (through its affiliate SG2, 40 percent), Rhone Poulenc (10 percent), and Puk (10 percent). Citroen is the job contractor for construction. In practice, the only manual intervention will take place at the beginning of the cycle for identification and initial clamping of the part on its pallet, or during the cycle if reprocessing is needed. Automatic balancing would have required shape-recognition devices, an approach which is considered too complicated at this time. In addition to the machining cycle, the program initiated by the code contains the washing program, metrology, and unloading. The clamped and coded part is then directed according to computer instructions to one of the machining centers by one of the self-propelled carriers. Each center has a tool loader with some 100 tools, allowing the successive fabrication of two parts, the one in process and the one on stand-by.

Machining times vary from 10 to 90 minutes. Successive tool feeding is achieved during idle time by the same carriers from the central store. Machine use is maximized by mixing various types of parts, for machining times longer than six minutes per cycle. Transfer time between two machines is on the order of one



Structure of the flexible shop. There are actually two complementary shops. Tool management and traffic on one side, fabrication, transfer, and inspection of parts on the other. (Documents Citroen)

- Key:
- (A) Tool stock
 - (B) Tool-measuring machine
 - (C) Manual preparation and sharpening
 - (D) Tool loader
 - (E) Guided tool-carrier circuit
 - (F) Empty pallet stock
 - (G) Loading, unloading, reprocessing
 - (H) Loaded pallet stock
 - (I) Guided part-carrier circuit
 - (J) Rejects
 - (K) Carrier maintenance
 - (L) Part-measuring machine
 - (M) Laser machine

minute, but a part will not necessarily be completely machined in a single center. The changing time for a tool from shaving to shaving is less than 30 seconds. Plans are to eventually connect the measuring machine and the machining centers: the exchange of information between the two installations should provide a real-time compensation for tool wear. The high unit-cost of parts (runs of 1 to 100) led to an early decision to salvage doubtful parts as much as possible. In this case, the part is reexamined in a special area and manually inspected. In favorable cases it can be reintroduced into the fabrication circuit after modification of the process. The process is rigid (one process for one part) and is performed in CFAO. The carrier circuit is a closed loop without intersections. Traffic is resolved on the principle of waiting lines (buffer zone at the center of the shop). Operation of the overall installation was simulated on the Amdahl V5 computer at Quai de Javel.

The profitability of the system is maximized for runs of 20 to 150 parts, corresponding to the requirements of a PMI for general machine shop work. In the case of PSA, the system affords a three-fold reduction of fabrication lead times for prototype car components, which are currently of the order of 50 days with standard equipment. In the case of absolute priority (replacement or modification of a component for a vehicle undergoing testing), loading is immediate. A complicated part can therefore be produced in less than two days. All the machines are equipped with self-diagnostics and fail-safe systems (interlocking in case of tool breakage). Breakdown of one of the centers reduces the shop capacity by one-third.

In final analysis, the association of all these techniques multiplies the cutting time by four (60 percent compared to less than 15 percent in a conventional shop). Three people are in charge of fabrication: one for loading and palletizing, one for reprocessing, and one for supervision. Three others take care of the tool shop. The unit will operate with three shifts.

The final objective of Citroen and Automatique Industrielle is to establish a totally integrated and autonomous shop. The plans are to eventually add preventive tool-breakage detection. Statistical methods will be used at first. After 1983, sensors will be integrated into the tool heads, to continuously measure motor power variations.

11,023

CSO: 3102/373

INDUSTRIAL TECHNOLOGY

LATEST TECHNOLOGIES APPLIED AT CHARLEVILLE FOUNDRY

Paris INDUSTRIES & TECHNIQUES in French 10 Jun 81 pp 37-41

[Article by Jean Deflacieliere: "The Superlative Foundry is French"]

[Text] Better quality parts at significantly lower prices. Personnel escapes the inferno of conventional foundries. Information processing, robotics, microprocessors.

In 1972, Citroen had assigned to Guy Latchague the task of creating a clean, competitive foundry to eventually replace the one in Clichy. He has succeeded so well, that today it would be quite difficult to find a more modern one. As he modestly says: "They envy us." His Italian and Japanese competitors want to buy the special, one of a kind, machinery invented by the engineering department of the company. His secret? Tenacity: "You must know what you want, know how to explain it, and know how to wait until the technicians find the answer."

The enterprise supplies most of the company's plants. It also supplies the parts used jointly by Peugeot, Renault, and Volvo. The ferrous section (sand process) produces rotating parts in grey cast iron: brake drums and disks, engine flywheels. But especially safety components in GS iron (with spheroidal graphite) such as steering pins, suspension arms, camshafts, and so on. Aluminum alloys are used for chill-casting engine heads, gearbox cases, and pistons.

A plant of this size, able to deliver over 300 tons of cast iron and 120 tons of aluminum daily, cannot be improvised overnight. Its design and construction cannot be anything but gradual, especially since there was no question of abruptly cutting back Clichy's activity, and since this investment of over one billion francs had to become profitable as soon as possible.

Since the start-up of the first line in April 1974, the foundry has steadily rounded out its production facilities and increased its manpower, which currently numbers about 1300 people. Changes have been so rapid that visitors from headquarters no longer recognize the equipment. For Guy Latchague, this continual flux constitutes the major difficulty of his enterprise: "To establish a plant which can remain up-to-date for about 30 years while technology evolves very fast." It was therefore necessary to make use of what was available at each stage while planning later adaptations to higher performance equipment. A technologic cross-section thus discloses the successive stages of progress: electromechanical relays in a first phase, followed by 40 programmable automated units in the second one, ending with the arrival of microprocessors in the most recent installation.

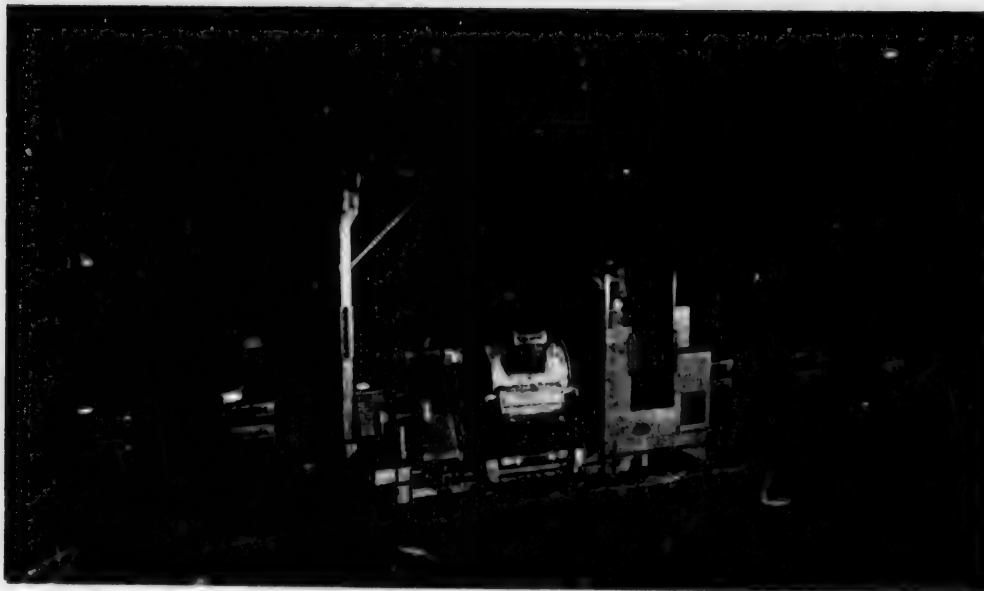


Every day, 160 tons of cast iron and 33 tons of aluminum are brought in the receiving ladle by travelling crane, after the furnace is tipped by push-button control.

From the very beginning, information processing played a crucial role in defining the project. In any case it would have been inconceivable to add it after the fact: it comes into play in real-time in all aspects of the plant's activity, from supporting local sequential commands, to performing the most varied management tasks, and including such process controls as metal formulation or cast moldings. This hierarchic system relies on two mainframes and 10 process computers. The data is obtained from 6000 points and 400 sensors which measure weight, temperatures, as well as water, electricity, and compressed air flows; 139 terminals and printers are scattered throughout the enterprise. One employee monitors the general installations from the central control room. In case of mishap, which is immediately displayed on the console, the employee has 1000 remote controls with which to start a given dryer or compressor, or to stop a machine, or else to decouple one section of the foundry. If necessary, the employee can also alert central maintenance, or one of the maintenance teams which have been decentralized for speedier intervention.

A logbook records all changes in conditions, wherever they may occur in the plant. Maintenance uses it to trace deviations in machine cycles with respect to the norm. Imperceptible to the naked eye but scrupulously recorded by the computer, microstops in the line can signal potential breakdowns. These observations are of considerable value: they provide the tangible foundations for preventive maintenance.

This computation capability also makes it possible to direct the start or unloading of electrical machinery, so as not to exceed the ceiling authorized by the EdF (Electricite de France) contract. It is easier to understand the importance of this management when one realizes that each of the three arc-furnaces consumes as much as a 3500-employee assembly and machining plant. The foundry's total kilowatt consumption equals that of the city of Charleville.



Along a 492-meter conveyor, the molds travel at constant speed in front of the ladles whose load is electronically measured.

The automatic devices have become too numerous for anyone to keep track of. Robots ladle out the aluminum in the chill-molds, while others manipulate molten clusters or place cores in position. Special machines form cores, remove clusters, deburr, or control. Stripping and tumbling drums, 16 meters long and 4 meters in diameter, separate the parts from the sand, clean them, and lower their temperature from 600 to 60 degrees.

Iron casting is one of the most spectacular of the applications of this process. A few seconds are enough to change tools even though they weigh nearly one ton. The mixture of sand, clay, coal dust, and water falls on the chassis halves mounted on the steel molds. The machine scrapes and tamps. A conveyor brings the mold halves to assembly stations. Formerly, all of this was accomplished manually with hoists, whereas today, one technician watches the operation unfold on the indicators, screen, and printer of the "control tower." Alain Beaujot, responsible for methods, is equally proud of the automatic casting of ferrous metals. Three hundred molds constantly move along the line. The central computers determine which of them is to be filled; the casting carrier is indexed before that mold and releases the required quantity of metal.

Automation Has Altered the Rules of the Game

The most notable feature of the aluminum alloy area is the distribution of the sand needed to form cores. Two buckets are loaded under the mixers and move to the coring machines on a monorail over 100 meters-long.

After casting, robots move the parts to the cluster removal and core extraction station, and then to finishing. Next comes the major innovation which consists of recovering the sand, after the resins which lent it cohesion are incinerated. The savings amount to about 120 tons per day, not even counting the expense of mandatory transportation to controlled disposal sites.

Another spinoff of data processing is that automatic quality control changes the rules of the game. Some fifty parameters determine whether a part is well cast: metallurgy, clay, and coal dust content of the sand, granulometry, humidity, and so on. Until now, one managed for the best, playing it by ear, for the simple reason that a chemical analysis of the casting meant a three-day wait.

At Charleville, casters take a sample from the furnace and send it to the laboratory by pneumatic tube. Determined by spectrometry and calculated on the computer, the composition of the metal is displayed a few minutes later on the terminal in their shop, with indications of the fine adjustments that need to be made. The sands are themselves continually checked by probes inserted in mixers which handle two tons every four minutes.

The plant has no less than five laboratories (chemistry, sand, non-destructive testing, and so on), which employ 25 people and analyze samples. The fabricators perform their own unit tests of safety components, using Foucault currents and magnetoscopy. All these efforts pay off. Casting now produces parts which at one time had to be forged. GS iron no longer requires thermal treatment, and Alain Beaujot is now amused by the installation designed to reprocess excessive or inadequate hardnesses: "We don't use it much."

Automation is reflected in cost reductions of 20-30 percent. An equivalent production with conventional means would have required three times as much manpower. For the workers, modernization means above all, radically changed living and working conditions. Mr Lernoux, personnel director, would not like to see the plant represented "in an idyllic light, like a paradise." But we are far from the inferno of traditional foundries. This is evidenced by the rate of absenteeism (less than 9 percent), which is comparable to that of the company as a whole, and is also less than one-half the rate for foundries in the Ardennes region; additional evidence lies in the exceptionally low personnel turnover (2-3 percent).

Silicosis has of course disappeared and safety is scrupulously watched: "When he enters the plant, the worker does not have to wonder whether he will come out in one piece." A specialized engineer studies each new machine, and its placement in service requires his approval. As a result, the accident rate is 13 instead of the usual 100 (per 100,000 work-hours).

Here you will certainly never see what you still see in other recent foundries: men standing on gratings, breaking up sprues with 1.2-meter sledges. Nor will you find casters vibrating powdered coal and sand to fill the molds. Nor manual handling of 150-kg casting ladles. Nor workers bent over inside a coring machine. Robotics has freed the workers from the demanding and dangerous operations which brought them in direct contact with the heat released by metals, or with dust and noise. The machine now endures the hardship. Everything has been done to keep the worker away from harmful environments. Arc-furnaces still operate at 1400 degrees and more than 100 decibels, but employees no longer have to work near them in Charleville. The operator remains some distance away in his air-conditioned control room. In any case, all the shops are kept dust-free and heated by a system which circulates one million cubic meters of air per hour. The noisiest areas have also been carefully sound-proofed: the arc-furnaces are surrounded by concrete shells and removable covers, and the tumblers are isolated in booths.

Men are no longer required to run or use their muscles, but to operate and control. These enhanced tasks are entrusted to more highly qualified workers: 40 percent of them are professionals, and one-third of these are assigned to maintenance, which is becoming a vital function because of robotics. Women (20 percent of the work force) are also finding opportunities: there are as many of them in the shops as in the offices. Naturally, all this requires training efforts to match the novelty of the technologies that are used.

Doubled Aluminum Capability, Improved Casting Finishing

Management attaches great importance to employee participation in the enterprise's productivity and quality objectives. In order to increase worker responsibility it integrates more and more of the control functions into production. Innovation is encouraged by a suggestion system and by forming work teams for specific problems. The personnel thus generates nearly 2000 improvement suggestions per year. Citroen also insisted on demonstrating that industry does not necessarily mean pollution, as long as there is a determination to maintain it clean. The buildings are surrounded by green lawns and flowering trees. The only trace of activity is a thin water vapor plume above one of the stacks. Other nuisances have been radically eliminated. Arc-furnace fumes and dusts are sucked into filtering installations. The air in the shops is also passed through purifiers before venting. A settling pond treats the waste water and tests it before release. And finally, casting scraps, sprues, saw shavings, and rejects are recycled by melting.

Despite the profusion of state of the art technology in every nook and cranny, the Charleville foundry will not finalize its equipment for some time to come. There are already plans to double the aluminum capability, to refine casting finishing, and to create 700 jobs between now and 1985. Another major first is also being planned: automatic delivery of cores from stock to molds, under the control of central data processors, using carriers guided by wires embedded in the floor.

11,023

CSO: 3102/373

INDUSTRIAL TECHNOLOGY

COMPANY WILL MARKET SMALL, MODULAR FLEXIBLE WORKSHOP

Paris L'USINE NOUVELLE in French 30 Jul 81 p 47

[Article by Daniel Coue: "Flexible Workshops Also for Assembly"]

[Text] The concept of flexible workshops is not reserved exclusively for fabrication. Assembly operations are also included. Especially for short runs. The equipment will be inexpensive and well adapted to PME (Small and Medium-Size Enterprises) needs.

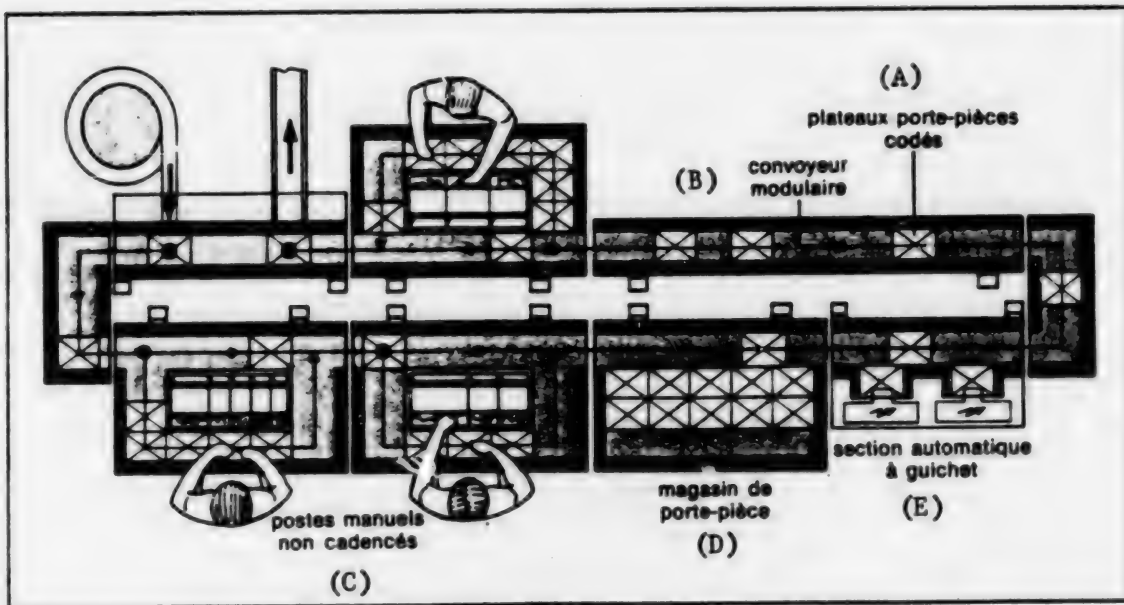
At first sight, the prototype unveiled by Prodel Automation is just another assembly machine; and yet it portends the first flexible workshop ever built in Europe.

In fact, it is flexible in every sense of the word. This concept will make it possible not only to assemble several different products in short and medium-size runs, using the same equipment, but with time, will also enable a great many changes in product design or production size. All of it at the cost of easy and inexpensive transformations or extensions of the installation.

"Actually, since its construction is based on standard modules, our flexible assembly workshop will be reusable, and even negotiable, when the assembly or assemblies being manufactured are outdated," points out Jean-Paul Delaveau, marketing director of Prodel. "It is the universe of rational assembly, applied to limited runs. And with prospects for enormous productivity increases."

In particular, this should fit the needs and means of PME's. "Actually, that is why we relied on rather simple technologies and components, as well as on easy operation," adds Jean-Paul Delaveau.

Each basic module has its own electric motor drives, and is first of all a portion of an endless conveyor operating on the principle of free transfer of part-carrying trays. Each tray has a cam memory coded for the order of operations to be performed on the part. Depending on the stage of assembly, the tray recognizes the station at which it must stop. It is even possible to take into account the loading of each station.



An configuration example of the flexible assembly workshop. Each module, manual or automatic, is a portion of an endless conveyor operating on the principle of free transfer of part-carrier trays.

- Key:
- (A) Coded part-carrier trays
 - (B) Modular conveyor
 - (C) Untimed manual stations
 - (D) Part-carrier storage
 - (E) Automatic section with slot

Introduction at the Beginning of 1982

The manual modules have a by-pass from the main flow, in which several trays can accumulate. They are then advanced by a pedal pressed by the operator. This flexibility is also found in the automatic modules, which can be equipped with slot systems which do not open to the conveyor tray during the operation time. Moreover, buffer storages are provided; they are distributed around the traffic flow, to allow the storage of trays and the regulation of traffic.

Thanks to this modular structure, it will be possible for instance, to upgrade the installation toward progressive task automation, without complete redesign of the basic production equipment. Therefore, the solution adopted and applied almost immediately, will always conform to the optimum conditions compatible with the production rate. And of course, the launching of a new product, similar or not to the first, will not necessarily imply the installation of a new line: a few new modules will be sufficient. This will result in space and manpower savings, and in a substantial reduction of initial investments, since the price of a module, whether manual or automatic, should not exceed 28,000 francs.

Introduced as a result of a development contract, and partly financed by Codis (Steering Committee for Development of Strategic Industries)--the support will be continued by Anvar (National Agency for Implementation of Research)--this study has already been well received by industry: Telemecanique expects to adopt this system for assembling contactors, Salomon for ski assembly, and Black and Decker, SEB, and Verto (Valeo Group) for complete assembly of various devices. The first placement in operation will occur at the beginning of 1982.

Until then, the operating principle will be studied further. "In any case we will retain the solutions currently adopted, and the pneumatic servos in particular, because they are still the least expensive," predicts Jean-Paul Delaveau. "But to improve flexibility and versatility we will have to have recourse to other processes." For this, Prodel has just started--with the University of Compiègne, located very near the Carlepont plant--a study on the use of bar-codes. The tray markers will be read by optical readers located upstream of each traffic node, and the entire system will be managed by a programmable automatic device. "It will be most sophisticated," concludes Jean-Paul Delaveau. "But even at the present state of things, we believe that we can meet a good many needs."

11,023

CSO: 3102/374

INDUSTRIAL TECHNOLOGY

AUTOMATED PRODUCTION OF NUCLEAR-RELATED CATALYTIC ELEMENTS

Paris L'USINE NOUVELLE In French 30 Jul 81 pp 43-45

[Article by Jacques Antoine: "Rapid Production and Quality Are Compatible"]

[Text] Decouple operations by interposing dynamic buffer storage, place several machines in parallel per operation, integrate real-time control at each station; these have been Sfec's (Company for Catalytic Element Fabrication) solutions for the extremely rapid production of a complex and fragile product. A model of integral automation.

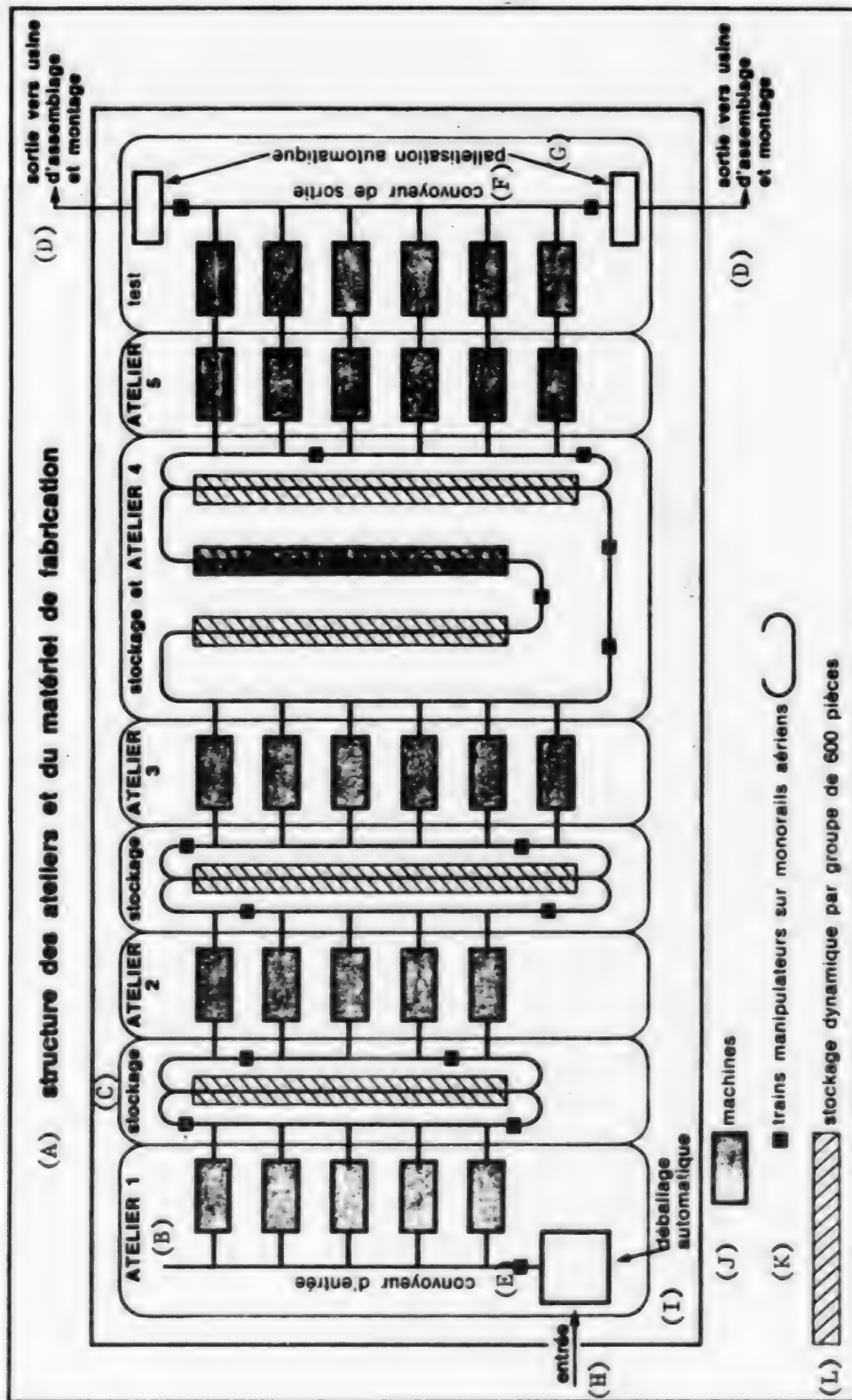
The problem: manufacture more than 100 million units of a very fragile part in the limited time of five years; unique, this part is intended for a single customer whose quality requirements are very demanding. The nuclear industry does not cut corners! Question: how to produce it?

This was the problem handed to Sfec, when it was asked to supply diffusion barriers designed for the Eurodif uranium enrichment plant. At Tricastin-Pierrelatte, the solutions adopted and used since 1976 are practiced in two plants; one for step manufacturing (sequence of operations), the other for installation and assembly. The two plants are entirely automated: the parts are never touched by human hands.

What are the various fabrication operations? Protected by the "national defense" secret classification, their description is out of the question here, although L'USINE NOUVELLE has had the privilege of learning the entire process. However, the exemplary nature of this automation--entirely French it should be added--deserves our attention, even though it concerns a one-product and one-customer industry. The situation may be quite unusual but not the constraints: these can be of a socioeconomic nature (cost reduction and manpower problems), or technical (process reliability and product quality).

30,000 Logic Input-Outputs

The first constraint is that the product--a ceramic tube two centimeters in diameter and about one meter long--is fragile. Manual handling results in a lot of breakage. Moreover, any grease and dust contamination is prohibited. "We have automated the operations as well as the handling between work stations," explains Rene Rouviere, technical director. The second constraint is that the required production rate is



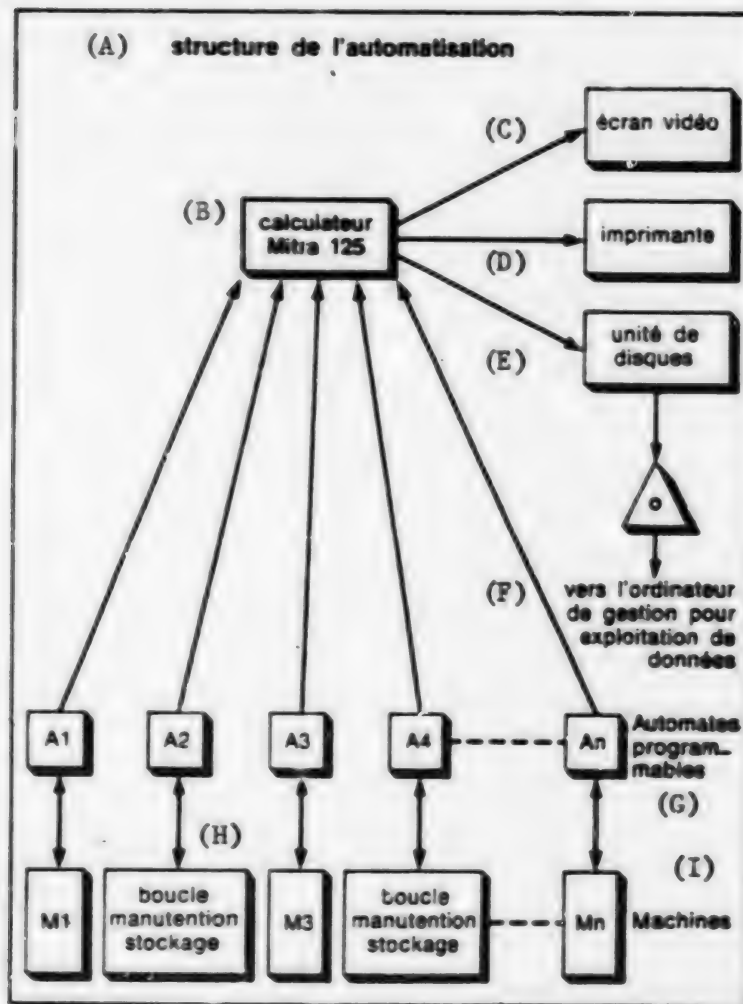
With a dynamic buffer storage between each operation, parts in process take second place. In order to maintain very high production rates, the loading of work stations has priority. Any one machine in a shop can thus supply any other machine in the next shop. The keystone of the system is a network of programmable controllers supervised by a computer.

- Key: (A) Structure of shops and manufacturing equipment
(B) Atelier = shop
(C) Stockage = storage
(D) To installation and assembly plant
(E) Input conveyor
(F) Output conveyor
(G) Automatic palletization
(H) Input
(I) Automatic uncrating
(J) Machines
(K) Handling trains on overhead monorails
(L) Dynamic storage in groups of 600 parts

infernal: of the order of two to three parts per second! "When needed, we have put in service several machines per operation." Which, we should add, must be adequately supplied. "We have adopted shops specialized by operations, with the machines in parallel. Each of these independent modules is supplied from a dynamic buffer stock--with the first-in parts being the first ones out--which acts as an interface between two successive phases of the process." The third constraint is that the fabrication must have a large number of systematic unit verifications, whose results must be immediate in view of the production rate. It is out of the question in fact, to complete a part damaged during an operation. "We have integrated automatic controls at each station. A defective tube is rejected on the spot. On some machines, the tooling involved is also removed for checking."

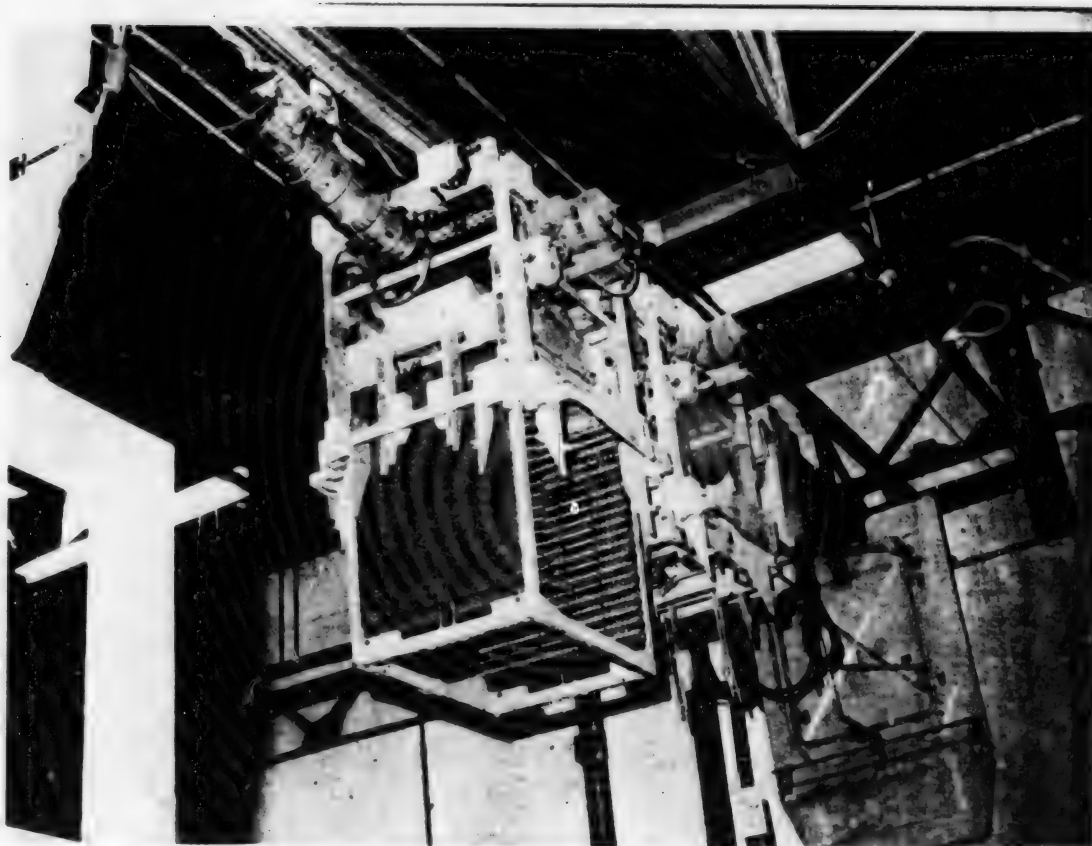
The operations being sequential, the control of the process has been turned over to programmable controllers (sequencers); there are about 35 of them in the manufacturing plant, and they are connected to a computer. The assembly plant is not far behind with some thirty controllers. All in all, this represents some 30,000 logic input-outputs. Probably a record in France! "We have decentralized the controls for operational safety reasons," explains Guy Palmier, one of the automation specialists at Sfec. "Only the supervision has been entrusted to the central computer. We did not want to run the risk of a general breakdown." To which, Rene Rouviere adds: "The most delicate aspect of automation is the start-up and rate build-up of the machines."

Like surgeons, dressed in white coats, let us enter the first plant. The atmosphere is perfectly controlled. Cleanliness requirements are such that the machines are designed to operate without lubrication, and the exhaust of pneumatic cylinders is collected to avoid oil mists. The rough tubes, manufactured by Euroceral and Ceraver, arrive in racks enclosed in containers. Automation begins from the moment they arrive. They are opened on a special machine, and an overhead conveyor supplies the five machines of Shop No 1 with racks. Each machine is directed by an controller with an average of 400-500 input-outputs (CIT-Alcatel and a few CGE Alsthom), with photoelectric or capacitance detectors verifying the presence of the parts. According to Charles Oliveira, responsible for the controller department at Sfec, the list of of these measurements at work stations located in various shops is a long one. "To control the presence of a metallic deposit, the speed of wire feed, permeability, temperatures, mechanical resistance, water tightness, and so on." This drastic quality control goes beyond the rejection of defective parts; at some stations, a loop is formed between the control and adjustment of machines upstream from it.



The Mitra 125 central computer has no command function, and merely receives information from the controllers; this provides a real-time picture of the plant's operation.

- Key:
- (A) Automation structure
 - (B) Mitra 125 computer
 - (C) Video screen
 - (D) Printer
 - (E) Disc unit
 - (F) To management computer for data analysis
 - (G) Programmable controllers
 - (H) Handling and storage loop
 - (I) Machines



Depending on the upstream and downstream information, a handling controller on the floor orders this handling train, moving on a monorail and controlled by a small on-board controller, to supply the next available machine. In front, empty, the system which supports the racks for 600 parts.

All Programs Can Be Manually Overridden

Each machine controller directs the steps and supply of its station, supervises product control (performance of measurements), tallies part loading and unloading (data transmitted to the central computer), assists the operator--or rather the attendant--(message posting), detects defects and informs the computer for maintenance diagnostics. "All the programs can be disconnected and run manually by the operator if problems have to be corrected," says Jean-Pierre Crouzet, head of the plant.

Part of the information is directed to a management controller associated with each handling line. Thus, if a machine runs short of parts, this handling controller directs the conveyor to immediately supply racks. The same principle prevails in successive shops, separated by a dynamic buffer storage. Depending on the upstream and downstream information, the handling controller commands a handling train, running on an overhead monorail and controlled by a small on-board controller, to service the requesting station. "The system reduces waiting time to a minimum," says Jean-Pierre Crouzet. "We had a problem with coincident calls," adds Guy Palmier. "Assuming that the five machines in a shop are at the same step, they cannot be supplied simultaneously by the two trains on each rail. The handling management controller must therefore anticipate machine demand."



In the diffusion barrier assembly plant, an automatic machine for parts preparation. Quality controls are conducted at each work station.

The dynamic storage system does not concern itself with parts-in-process. The loading of the 450-odd work stations has priority. Any one machine in a shop can supply any other machine in the next shop in the sequence. For Jean-Pierre Crouzet, the advantages of modularity are: "Flexibility above all. We can withstand any mismatches between consecutive shops resulting from irregularities at work stations. Buffer storage also simplifies maintenance."

The central minicomputer, a Mitra 125, has no command functions. "It merely receives the information from controllers, which provides a real-time picture of the plant's operation," explains Rene Rouviere. "It is a tool for statistical determination of yields, operation rates, rejects, and so on; it is also a valuable help for maintenance." The information stored on floppy discs is later used on a more powerful central computer (IBM) which prints weekly and monthly reports.

The installation and assembly plant operating at a less spectacular rate, is equally as automated. Here, the tubes are assembled into one unit, the diffuser, which resembles a large tubular exchanger. Eight tubes joined end-to-end form a candle. A group of candles is banded together into a bundle. The automation stops at that point. Several bundles are then installed in a metal shell to form a diffuser.

Breakdowns: Three Percent Due to Automation

"As in the preceding plant, we perform quality controls of all kinds, essentially pneumatic and mechanical ones, at each station," states Raoul Pimprenelle, who also adds that "all these special machines are French."

After five years of operations, Charles Oliveira takes stock: "Product quality has remained stable, handling breakage has become negligible whereas it used to exceed 6 percent in manual operation for similar production at Pierrelatte. Rejects have also been reduced by a factor of three. The computer information is very useful to quality control, to the head of production, and to the person responsible for maintenance. Finally, the machine operation rates are very high (about 70 percent!), and breakdowns traceable to automation are rare, of the order of 2 to 3 percent of all incidents."

A positive balance. And an experience which the Sfec managers expect to exploit. Delivery for Eurodif has been completed. A similar program for Coredif, affected by the worldwide nuclear power slowdown, has been postponed to an undetermined date. The rapid manufacturing rates will therefore come to a stop in July. An investment of 280 million francs (1976) will soon be idle. Confident in its expertise, and mindful of diversification, Sfec will offer to industry a mechanical and automation engineering service.

11,023

CSO: 3102/374

SCIENCE POLICY

FRG'S POSITION IN WORLD R&D COMMUNITY ASSESSED

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 17 Jul 81 p 7

[Article by Dr. Werner Gries: "Japan Dominates in Civilian Research"]

[Text] Frankfurt, 16 July--Information on research expenditures and the number of employees engaged in research is of utmost importance in judging the competitive position of the German economy, although that still says nothing about its ability to innovate. But research and development are the prerequisites sine qua non for solving the problems of the future. FRG research expenditures from 1969 through 1980 are shown in Table 1.

Table 1. FRG Research Expenditures and Research Personnel¹

Year	Total Expenditures in DM billion		Employees	Industry Expenditures in DM billion		Employees
	nominal	real ²		nominal	real ²	
1969	12.25	13.14	247,176	7.30	7.83	174,791
1970	14.80	14.80	268,000	9.00	9.00	183,000
1971	18.00	16.71	297,114	10.70	9.94	199,245
1972	19.25	16.93	299,000	11.40	10.03	194,000
1973	20.46	16.96	303,838	12.01	9.97	188,558
1974	22.29	17.29	303,304	13.24	10.27	187,000
1975	24.65	17.91	303,114	14.93	10.85	186,252
1976	25.74	18.13	n.a.	15.69	11.05	n.a.
1977	27.34	18.55	319,347	17.36	11.77	197,800
1978	29.85	19.48	n.a.	18.71	12.21	n.a.
1979	32.78	20.60	n.a.	20.72	13.02	n.a.
1980	34.72	21.29	340,000 ³	22.00	13.49	206,000 ³

1. Source: federal research minister, statistical information, Bonn No 1/81

2. According to the gross national product price index with 1970=100, author's calculation

3. Author's estimate

The nominal research outlays normally given were in this table adjusted with the gross national product price index in order to approximate real expenditures over time. In the FRG about 340,000 are employed in the field of research facilities ranging from federal institutes to research centers and in universities.

Accurate data exist through 1977. In the period 1969 through 1977 the number of workers employed in the industrial research sector increased an average of 1.5 percent annually, whereas real expenditures went up 4.9 percent. This is a phenomenon which must be taken into account to a greater degree when considering research potential. Expenditures per worker increase more than proportionally in the area of research; this corresponds with the increasing capital equipment per job. The scope of scientific equipment and instruments is especially large in the research field.

For this reason there is no parallel development for real research expenditures and number of employees. FRG research expenditures for the entire national economy grew 3.7 percent per year in real terms during the period 1970 through 1980, and thus on the average increased more rapidly than the national product. Total research expenditures in 1980 accounted for 2.3 percent of the FRG gross national product. That is a very high value in comparison with other countries. But one should not overestimate the importance of this, because the absolute number of research employees is more significant in characterizing the research potential of a country. The FRG, which is very solidly embedded in international competition, must therefore pay special attention to the industrial research capability of competing countries. Indicative in this regard is the distribution of research personnel in the most important competing countries, shown in the following table.

Table 2. International Comparison of Research Personnel for 1977¹

<u>Country</u>	<u>Number</u> ¹		<u>Industry</u>	
	<u>Total</u>	<u>percent of OECD</u>	<u>Total</u>	<u>percent of OECD</u>
Total OECD	2,235,089	100.0	1,337,353	100.0
United States	576,400	25.8	393,700	29.4
Japan	564,915	25.3	305,742	22.9
FRG	319,347	14.3	197,800	14.8
France	222,111	9.9	120,800	14.8
Great Britain	259,600	11.6	180,600	13.5
Other OECD	292,716	13.3	138,873	10.4

1. Full-time calculation. Source: federal research minister, statistical information, Bonn no 1/81

Despite all of the problems with these figures, certain trends are apparent, which can be summarized in the following manner: According to the number of research employees, the United States and Japan stand about equal with approximately 570,000 employees each. They provide 51 percent of all research personnel in the Western World. The FRG, with 14.3 percent of the Western World's research personnel, is far behind the United States and Japan. The number of FRG industrial research employees is 55 percent smaller than in Japan. There are only half as many employed there in industrial research as compared with the United States. In terms of research personnel, the U.S. research capacity is twice as large as that of the FRG, and Japan has a capacity not much smaller than the United States.

An international comparison of research expenditures is almost meaningless, since varying exchange rates complicate the picture and price trends also vary markedly. In addition, pay scales differ widely. The number of research workers is therefore a much more readily comprehensible means of determining research potential. Serious for the German economy in this regard is Japan's dominant role in research in the Western World. The impact of this trend has been felt for several years in the world market and it will become worse in the future.

In the FRG personnel in industry is distributed with one-third in each of the categories, scientists, technicians and others. In the universities the portion comprised of support personnel is significantly smaller, and thus the portion of scientists and technicians greater. Considering the research intensity of individual branches of industry compared with total research personnel as an existing entity, the following distribution in percent results for the individual branches: Steel machinery and vehicles, 31.5; electric engineering, precision engineering and production of business machines, 31.5; chemical industry and petroleum processing, 28.9; other industrial branches, 8.1.

The distribution of research personnel is somewhat different in the United States, Great Britain and France. Military research and development is of great importance particularly in the United States. For this reason the aforesaid dominant Japanese role in research personnel is even more significant, because in Japan military research capacity on civilian needs. When one considers civilian research and development personnel only, then Japan is the leader within the Western World ahead of the United States. In part, this is occurring to the detriment of civilian research.

9746

CSO: 3102/361

TRANSPORTATION

CITROEN VISA II NEW TECHNOLOGY MOTOR

Paris L'ARGUS DE L'AUTOMOBILE in French 2 Apr 81 pp 16-17

[Article: "Citroen Via II: A Still More Economical Engine"]

[Text] Without question, the new Visa II Super E marks a stage in the recovery of PSA [expansion unknown]. The marriage of a Citroen body to a Peugeot engine had not yielded the anticipated results. The style (both interior and exterior) of the Visa had very little attraction, while the 104 engine, after all brilliant, had some sizable drawbacks, namely uneven idling, more than critical cold starts, all depending on the design of the intake pipe, unfortunately incorporated in the cylinder head.

Talking About Style Again

To return briefly to style before going on to the metamorphoses in the engine, in terms of anthropomorphism. The geometry of the "face" and of the "shapes" of our automobile companions give rise to a constant (but unexpressed) reference to human features in our minds. Thus, in the postwar automobile, the severity of the Peugeot 203 and 403, marvelously reflecting the steadiness and reliability of the make, were contrasted with the "feminine" seductiveness of the Aronde, whose headlight visors were even reminiscent of the eyelids and look of motion-picture stars. Closer to us, the advertising campaign announcing the Renault 5, with designed stripes, had provided it with eyes and a mouth (that talked), accentuating the likable and malicious side of the product (which was messed up by FIAT for the "malicious" Panda). The excessive, deliberate simplification of these examples must not make us forget that this unconscious perception of the model's personality and the harmony achieved with the buyer's sensitivity (regardless, moreover, of his sex) are both one of the greatest mysteries of style and, as a corollary, its most magnificent justification.

The narrow radiator grille of the former Visa I and the triangular hood that it necessitated reminded us of the architecture of the "2-legs." Therefore, it seems obvious that the "Special" and "Club" models were favored by the owners of Dyane and 2 HP 6, while the "Super" model found it difficult to compete with the Peugeot R 5 and 104, with more of a "big car" design, while they had, however, approximately the same dimensions and performance.

At the cost of more important modifications, now the Visa II is more attractive, more in conformity with the taste of the moment, provided with a much better "selling design." It is to be hoped, with the help of success, that one day they may

review the dashboard design. A priori, we are not opposed to the "goat's milk cheese" on the left (headlights, turn signals, and so on) or to the square of Brie on the right (heater), but there too it could be made more simple and restful to the eye without losing any of the ergonomic features of the unit.

"Vade retro"

The work performed by the Peugeot technicians when they modified the Citroen 104 engine and by Citroen technicians when they adapted it to the Visa II deserves telling, because it is exactly the opposite of what was done only 10 years ago!

At the time of the power race, fuel consumption was of moderate concern with a desperate attempt to attain higher power. Today, priority is given low consumption and everything making it possible to achieve it. In the 1- to 1.3-liter class, it is absolutely necessary to beat the "standard" that the engine of the R5 GTL, mostly responsible for the exceptional "multifaceted" image of the R5, has become.

Therefore, it will probably not be amazing to see that the PSA motor mechanics have used every "trick" of the trade to modernize the 104, including adoption of an electronic ignition system accomplishing what our grandparents were unable to accomplish in the golden age of the automobile, with their "tremblers" quickly superseded by magnetos!

The fact that the most modern techniques have a "retrograde" side does not displease us, insofar as there is a considerable number of clever inventions pertaining to the four-stroke engine that could not be carried through owing to a faltering technology but that can now be brought to successful conclusion thanks to ultraperforming metals, lubricants and electronic circuits!

Breathe!

A high compression ratio is the gauge of good performance. The 109/5E engine of the Visa II Super E increases to 9.7 from 9.2. This considerable increase has been achieved simply by means of a greater piston displacement, but it increases the need for using a quality superfuel.

The modification of the intake pipe is just as important. Previously integrated, it becomes only partly integrated, because the new design makes a better adjustment of the nozzles and balancing of feed possible. Up to now, the two center cylinders were rather richly supplied while the outside ones were rather poorly fed. Another advantage is that preheating of the carbureted mixture is improved. The result is that the cycle performance is improved and, owing to the greater cyclic regularity, it is possible to lower the idling rate from 900 to 750 rpm. Consumption is lower. This is especially noticeable in city driving.

Uncross!

A camshaft is said to be "crossed" when it makes simultaneous opening of the intake and exhaust valves possible for a certain period of time. The pressure waves created by the sudden expansion of hot gases cause a "compression" effect in the intake, admirably filling the combustion chamber with carbureted mixture. Most often, balance between intake-exhaust frequencies, difficult to achieve, occurs only at a high rate, but it increases the power of engines considerably.

The Visa Super E had a crossed pattern: AOA (advance on intake opening) of $5^{\circ}20$ in relation to the PMH (upper dead center of the piston), AOE (advance on exhaust opening) $36^{\circ}50$ in relation to the PMB (lower dead center of the piston), RFE (delay on exhaust closing) $5^{\circ}20$ in relation to the PMH.

With the new engine, they go from an AOA of $5^{\circ}20$ to an ROA (delay of intake opening in relation to the PMH) of 4° , while the RFE of $5^{\circ}20$ becomes and AFE (advance on exhaust closing) of 5° !

Thus, they have gone from a crossing of $10^{\circ}40$ to an "uncrossing" of 9° ! From now on we wisely expect exhaust to be closed 5° before PMH before opening the intake 4° after PMH!

This modification of the pattern is accompanied by a decrease in valve lifting from 8 to 7.35 millimeters. Thus, the gases are accelerated at low and medium speeds and fill the cylinders better. This results, still at these low and medium rpm's, in an increase in power and torque, reduction in the idling speed and lowering of the maximum torque rate.

Carburate, Ignite!

All the intake pipe and camshaft modifications make it possible to burn leaner mixtures (less rich in fuel). Therefore, the carburetor has been modified taking the following into account: nozzle 24 (25 for the old Visa), main jet 120 (127.5), automatic jet 150 (155), idling jet 41 (42), acceleration pump injector 35 (40). With regard to the full-load enricher, it is controlled mechanically and is, therefore, more accurate. It is possible to run longer with lean mixtures.

On the other hand, although these mixtures are more economical for the user, they are harder to ignite. Therefore, an ignition system with performance and accuracy has to be used. That has already been accomplished with a rather simple transistorized electronic ignition system.

It includes the following, in addition to the coil and the sparkplugs:

A distributor equipped with a traditional centrifugal advance mechanism, depression advance, an HT (high voltage) current distribution rotor.

A pulse generator. The traditional points have been replaced by a polar wheel (non-magnetic 4-armed star) turning in the field of a permanent magnet. It produces an induced current in the coil of the magnet (the collector).

An electronic module that triggers the ignition voltage at the rate of the pulses received from the generator. It consists of four components: a logic controller, a power stage (amplifier) and two control and reaction units (dwell and current reading).

The advantages of this transistorized ignition system are important:

It provides high energy (28 kilovolts) constant over the entire speed range, facilitating cold starts and combustion in general (less consumption and pollution).

Absence of friction and contacts frees it from maintenance and adjustment (the advance point remains stable).

Of course, adoption of this ignition system may seem to be a step backwards in view of the "all electronic system" promoted here and there, including by Citroen. Problems of feasibility, of cost and of maintenance, very familiar with this kind of equipment, show that Citroen decided on a certain wise course and shelved the more advanced technological dreams. Consumers and the network are grateful to it in advance.

In conclusion, we must salute this efficient job, which may seem to be going in a direction opposite to a certain evolution, precisely because it is going in the right direction, the direction of fuel economy, while not spoiling the pleasure of driving. Recently, a FIAT engineer who works on the future 1-liter PSA-FIAT, confessed his joy to us (and his amazement, it is true!) at collaborating with so well-qualified engineers. If there had been doubt for an instant of our technicians' worth, the 109/5 E of the Visa II would have provided the finest contradiction to these doubts.

Comparative Characteristics of the Visa II Super E, R5 GTL, 104 GR Models

	<u>Visa II Super E</u>	<u>R5 GTL</u>	<u>104 GR</u>
Engine			
Cylinder capacity (cc)	1124	1108	1124
Compression ratio	10.2/1	9.5/1	10.2/1
DIN power (horsepower-rpm)	50-5500	45-4400	50-5500
DIN torque (kilogram-meters - rpm)	8,4-2500	8.7-2000	8.5-2500
Fuel Consumption (in liters per 100 kilometers)			
At 90 kilometers/hour	5.1	4.9	5.2
At 120 kilometers/hour	6.6	6.8	6.9
Average, highway (90 and 120 km/h)	5,85	5,85	6,05
Average, city	7.0	6.3	7.3

10,042

CSO: 8119/1579

END

END OF

FICHE

DATE FILMED

3 Sept 1981